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BEN HILL GRIFFIN
President Florida Citrus Exposition

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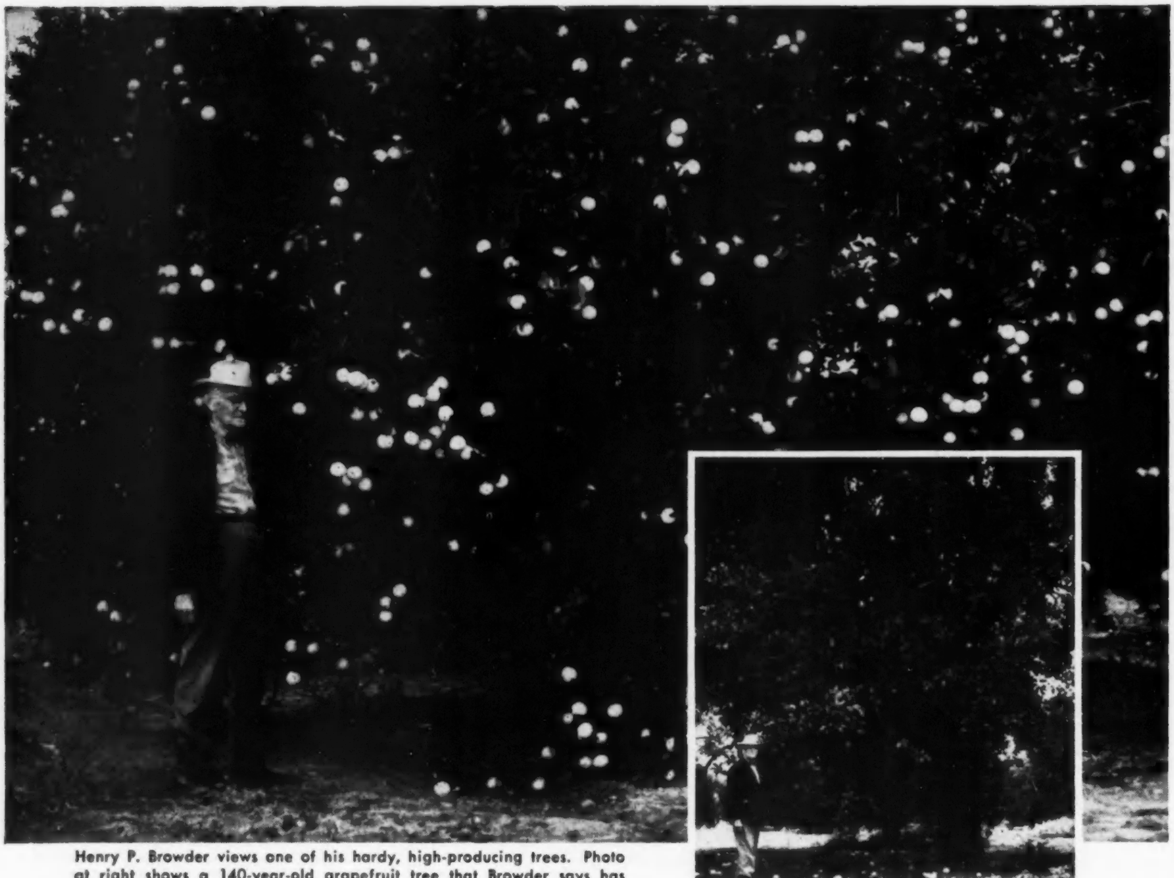

Henry P. Browder views one of his hardy, high-producing trees. Photo at right shows a 140-year-old grapefruit tree that Browder says has produced as high as 110 boxes of fruit.

"RAINBOW helped condition my trees ...saved them from killing freezes"

That's the enthusiastic report of grapefruit grower Henry P. Browder of Arcadia, Florida. "I've been buying fertilizers from International for 20 years," Browder says, "and two years ago I started buying their Rainbow Premium Plant Food. Rainbow increased production and improved the condition of my trees. There is no doubt that Rainbow helped protect my groves from losses during last year's cold weather."

Hundreds of other Florida citrus growers have shared Browder's experience. They know that Rainbow-fed trees are vigorous and healthy, better able to withstand cold weather. Why not get in touch with your Rainbow representative listed below. Let him tell you how Rainbow Premium fertilizer . . . fortified for higher profits with International's exclusive ingredient MEM . . . can improve yield and quality and boost your income.

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Citrus Insect Control For Spring 1959

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Authors' Note: Good control of major insects, mites, and fungus diseases of citrus requires a planned program of preventive measures, together with frequent grove inspections and supplemental spray applications if needed. In general, the spray program is designed around the yearly weather cycle and its effect on tree growth and insect activity. The cycle in Florida is divided roughly into four periods as follows: the important post-bloom period, the summer season when scale and mite activity reaches high levels, the fall period when scale and mite activity may be quite variable, and the winter dormant period when sprays for scab and mite control and for nutritional purposes may be applied.

To cover each of these periods with a complete control program, the monthly articles that have appeared in the past will be replaced by four articles to be published in February, May, August, and November. Special articles will be prepared whenever unusual conditions occur that require attention.

Red scale is the only major pest that reached an unusually high level of activity during December and January. In the three districts where activity is presently high, the high level is due largely to heavy infestations in a limited number of groves. Although a decrease in activity is expected during February, the level will remain above average through the bloom period.

Purple scale activity has been relatively low for the past two months and will continue to be low in February. Present indications are that infestations will not exceed normal levels through April.

Purple mite infestations have been slightly above average during the past month. The future outlook is for purple mite to continue near normal levels through February. Wet weather is known to have a marked influence on mite population. If rains are more abundant than usual in March and April, infestations will be held below average. A dry period could lead to a rapid increase.

Rust mite infestations last fall developed later than usual and reached a peak at above normal level during the first week in January. Activity generally will decline during the spring months but is expected to be slightly above average during most of the period.

Six-spotted mite will not be a problem this spring although colonies will be seen from time to time.

Aphid abundance usually is associated with a prolonged period of tender new growth. This situation is not likely to prevail this spring except where groves have been injured by cold. The Temple variety is quite susceptible to aphid attack and should be checked frequently.

SCALE AND MITE ACTIVITY BY DISTRICTS *

District	Purple Scale	Red Scale	Purple Mite	Rust Mite on leaves	Rust Mite on fruit
West Coast	2.61	2.93	1.25	1.90	1.55
Indian River	2.70	4.42	1.65	1.53	.89
Upper East Coast	2.45	—.15	1.71	.71	1.25
Gainesville	3.70	1.84	.67	.33	.67
Orlando	2.12	2.08	1.04	.65	0
Brooksville	2.23	.50	1.87	1.74	1.67
Ridge	3.84	4.44	1.48	1.96	1.89
Bartow	3.70	4.40	.70	2.40	2.63
State Average	2.86	3.46	1.35	1.48	1.33
Last Year	2.95	2.04	.66	1.44	1.07

* Second week in January. Activity is computed from populations, amount of hatching of scales, and number of groves with increasing or decreasing infestations. Activity is considered high if above 4.0 for purple scale, 3.0 for red scale, and 1.5 for mites.

SPRAY PROGRAM

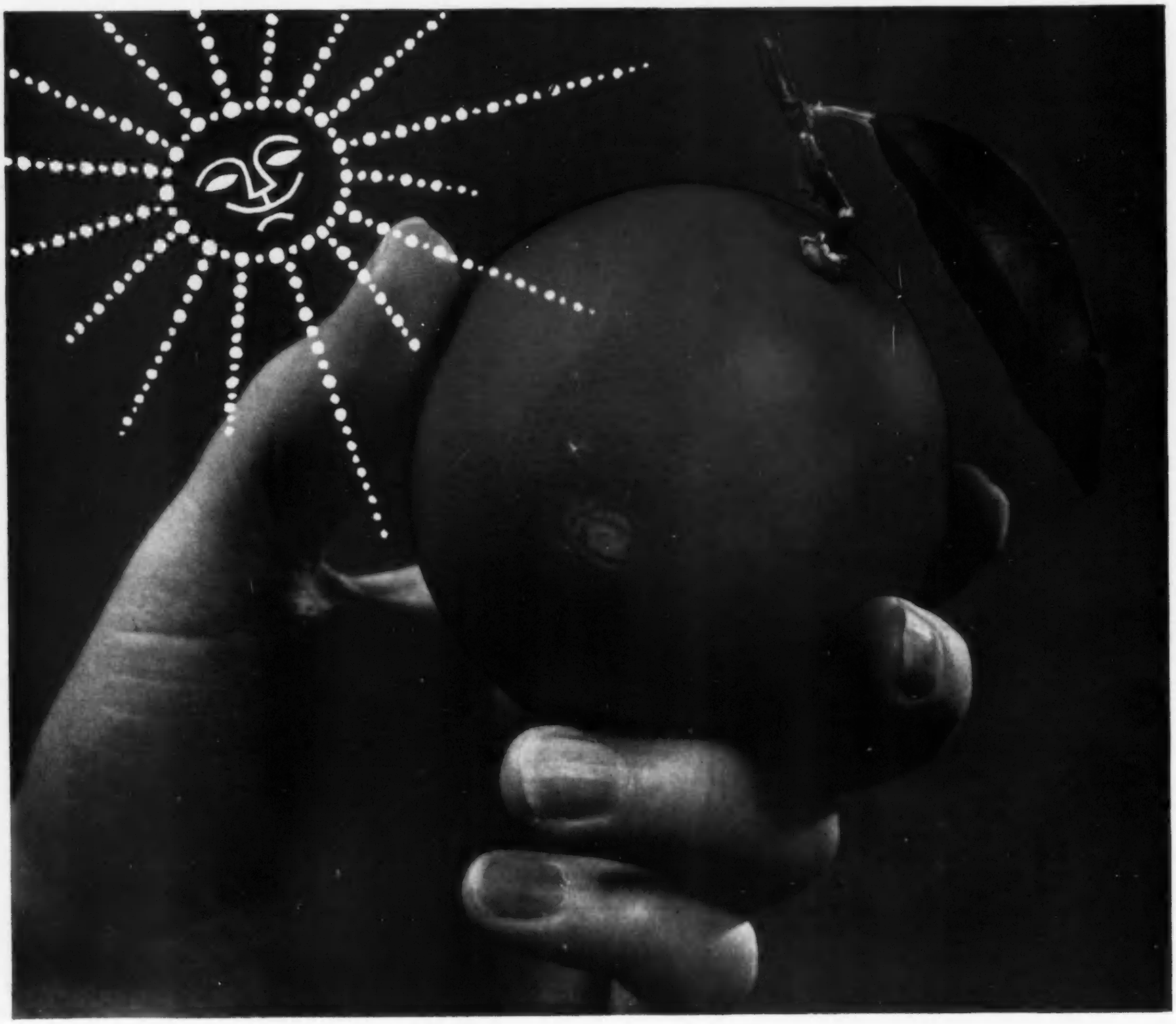
A post-bloom spray is recommended for all Florida citrus. In most years this spray is primarily for control of the diseases, melanose and scab, and for citrus rust mite, but in 1959, it may be equally as important for scale control. This year a post-bloom scalicide followed by a summer scalicide is strongly recommended. There is a good historical reason for this recommendation. The severity of the outbreak of both purple and Florida red scales after the freezes of 1957-58 was similar to the outbreak that occurred after the freeze of January, 1940. Since scale infestations were also severe in 1941, it is probable that in 1959 both purple and red scales will be more of a problem than can be controlled by a single summer application. This may well be true even where a scalicide was applied in the Fall of 1958.

Scale Control: The addition of a scalicide to the post-bloom spray will add very little to the cost per tree, but will reduce the infestation to such a low level that there will be comparatively few scales on fruit and foliage when the summer scalicide is applied. This will greatly increase the effectiveness of the summer scalicide, increase external fruit quality, reduce leaf drop and dead wood and in most groves, eliminate the necessity for a Fall scalicide.

At this point it might be asked,

(Continued on page 11)

*Written January 23, 1959. Reports of surveys by Harold Holtsberg, Fort Pierce; J. W. Davis, Tavares; K. G. Townsend, Tampa; T. B. Hallam, Avon Park; and L. M. Sutton, Lake Alfred.



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Relation Of Fertilization To Winter Injury Of Citrus Trees[1] ...

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Little information has been reported in regard to the relation of cultural practices to cold tolerance of citrus trees. The unpredictable occurrence of damaging colds makes it nearly impossible to conduct experiments primarily to give information on cold resistance. The meager published information is based on damage observed in experimental plantings that happened to be in existence at the time of a freeze. Such is still the case.

While such observations are of value, they may be misleading as to the true relation between cold tolerance and cultural practice since the infrequent occurrence of cold injury does not allow sufficient readings for one to arrive at conclusions that may be entirely sound. At best the information derived applies to a cold period that has already passed and may be of only limited value in future cold periods possibly at a different season or when the trees are in a different state of physiological activity. This being the case, much of the general knowledge on cold-hazard relationships is based on long-time grower experience. For instance, every Florida grower knows that it is risky to use practices that may force untimely growth in the winter and it has been a long-established practice to stop fertilizing young citrus trees in late summer so that they may be somewhat starved for nitrogen by the time a freeze might be expected. Such trees are more apt to be inactive, or "dormant" in winter than trees well supplied with fertilizer. Banking of earth around young trees as insurance against freeze injury to the trunk is a well-established custom that no doubt started from grower experience. Likewise, late oil sprays have been found by general experience to increase the susceptibility of plant tissues to cold injury regardless of the state of dormancy.

Another notion that has persisted through the years is that potash has a hardening effect on citrus trees that makes them less susceptible to cold damage and the excessive nitrogen increases susceptibility to cold injury (1).

Certain fertilization effects on the amount of cold damage in the 1940 freezes were described by Lawless (2) and Lawless and Camp (3). In brief, nutritional deficiencies, particularly of magnesium and copper, markedly increased the susceptibility of trees to cold.

In the spring of 1958, cold-injury ratings were made on trees in 12 large fertilizer experiments being conducted cooperatively with certain growers in Orange, Lake, and Pasco Counties. Most of the damage appears to have been done by the freezes of December 11-13, 1957, when temperatures of 18 to 22 degrees F were experienced in many areas of these counties. Several other below-freezing temperatures occurred in January and February and although they apparently did not damage the trees as much as the December freezes did they held them dormant and carried them through the winter with milder damage than might have been expected otherwise. In Pasco County, substantial damage to young trees was done by a freeze (near 20°F) on November 28, 1956. Some data are given on the damage from that freeze.

METHODS

A total of 4,000 visual ratings of extent of tree injury in over 1,000 fertilizer plots were made. Individual trees were scored numerically as follows:

0. No visible damage.
1. Very slight defoliation and occasional small bare twig.
2. About 50- to 60-percent defoliation, but very little or no wood damage.
3. About 75 percent defoliation

[1] Paper presented at the Fla. State Horticultural Society meeting in Clearwater, Oct. 30, 1958.

(60-90%), but little or no wood damage.

4. Total defoliation, but very little or no wood damage.

5. Total defoliation and considerable damage to outer twigs.

6. About one-third of outer canopy wood dead.

7. About one-half of canopy wood dead.

8. All but main branches dead.

9. All but trunk dead.

10. Dead to ground or below bud union.

The high-lights from these evaluations are presented briefly along with pertinent mentions of the differential fertilizer treatments.

RESULTS AND DISCUSSION

Since no critical deficiencies are being studied, virtually all trees were free of deficiency symptoms and the overall effects of differential fertilization on cold injury are relatively small. Under these conditions the size of tree and the density of foliage, for whatever reasons, were more important factors than the effects of the levels of specific nutrients within the plant. Some of the differences in degree of cold damage shown, although rather small, are of importance because they tend to be contrary to popular opinions.

Nitrogen rate.—Studies on the effect of nitrogen rate on oranges (4) and grapefruit (6) have been reported. Cold damage to orange trees in the present experiments ranged from none to slight at two experimental sites (Windermere, Montverde). The mean cold-damage scores given in Table 1 are from the Montverde experiment along with those from the Marsh grapefruit test near Groveland. Typical composition of the major elements in 4-month-old leaves is also given. Both blocks contain plots which receive about 2 and 4 pounds of N per tree per year. The fruit of both varieties was heavily damaged but the damage of the grapefruit was greater. Wood damage was negligible in both varieties, but the grapefruit lost about half of their leaves immediately following the December cold. Nitrogen rate has not affected yield of either variety for the past 5 years which leads to the conclusion that the higher level is a luxury amount. While the effect is relatively small, there is a clear-cut tendency for high nitrogen to reduce injury of foliage. The only explanation offered is that nitrogen in leaves is inversely related to the water content of the tissues (7). Reduced moisture content may increase the tolerance of cells to low temperatures.

TABLE 1. RELATION OF NITROGEN RATE TO COLD DAMAGE AND LEAF COMPOSITION OF 16-YEAR-OLD VALENCIA ORANGE AND MARSH GRAPEFRUIT TREES ON ROUGH LEMON ROOTSTOCK

Pounds Nitrogen	Cold Damage Score	N	P	Dry leaf composition (%) K	Ca	Mg
		Valencia Orange				
1.8	0.64	2.87	0.138	1.47	3.25	0.46
3.6	0.47	3.05	0.131	1.40	2.96	0.56
Significance	**	**	**	N.S.	**	***
		March Grapefruit				
2.0	1.78	2.64	0.131	1.90	3.84	0.48
4.0	1.52	2.86	0.128	1.71	3.70	0.49
Significance	*	***	N.S.	***	N.S.	N.S.

N.S. - Difference not statistically significant.
* - Difference significant at odds of 19:1.
** - Difference significant at odds of 99:1.
*** - Difference significant at odds of 999:1.

Nitrogen timing.—The effect of method of timing nitrogen application is also being studied in the Valencia orange block near Montverde (4). A single application of all the nitrogen at both the 1.8 and 3.6 pound rates in October or in February are compared with three applications a year. The differences in cold-damage rating were not statistically significant, but the respective scores of 0.49, 0.66, and 0.52 are inversely related to the leaf nitrogen at this time of year (4), again indicating that the amount of nitrogen in the tissue has some effect on the tolerance of the tree to low temperatures.

Nitrogen source.—Ammonium sulfate (S3) was found to increase cold-damage susceptibility significantly in the grapefruit test near Groveland as compared with calcium nitrate (S1) and ammonium nitrate (S2). The scores and the mean leaf composition are shown in Table 2. As shown, freeze damage was increased by ammonium sulfate at a constant level of nitrogen in the leaves. These cold-damage scores parallel the leaf-potassium values, and for the moment it suffices to state that it seems highly probable that the increased potassium content may have contributed to increased cold injury. This will be discussed under the section on potassium. However, visual observations prior to the cold showed that the foliage of many of the trees on ammonium sulfate nitrogen appeared to be slightly thin and lacked the luster that characterized the trees on the other nitrogen sources. These factors in turn appear to be related to low-subsoil pH. So it is possible that nitrogen-sources effect on cold damage to tree may be all or partly an indirect one associated with reduced tree vigor.

Phosphorus rates. — A test near Tavares with Pineapple orange on Rough lemon stock is now in its sixteenth year from planting on virgin soil. Superphosphate from the start has been differentially applied in the following ratios: 8-0-8, 8-2-8, 8-6-8, and 8-16-8 plus secondaries (5). The entire crop of fruit was badly damaged by the freeze and considerable defoliation and twig damage were evident in part of the experimental block. The mean cold-damage scores for trees on these treatments, respectively, were 1.17, 0.90, 1.18, 1.18, with no statistical significance.

Potassium rates.—Three rates of Marsh grapefruit have been under study for the past 5 years in the Groveland location. Current application rates are 0.5 pound of K_2O per tree per year, 2 pounds, and 5 pounds supplied as the double-salt sulfate of potash-magnesia. There have been differences in yield and fruit size associated with treatment, but tree condition has been practically indistinguishable and would be classed as very good. Obvious differences in extent of cold damage were present with less than 10-percent defoliation on the low-potassium trees and about 30-percent defoliation on the high-potassium trees. Damage scores and a typical leaf analysis are shown in Table 3. While the difference in cold damage is relatively small numerically, it is of

TABLE 2. EFFECT OF NITROGEN SOURCE ON COLD DAMAGE TO 16-YEAR--OLD MARSH GRAPEFRUIT TREES ON ROUGH LEMON ROOTSTOCK

Nitrogen Source	Cold Damage Score	N	P	Dry leaf composition (%) K	Ca	Mg
S1	1.56	2.75	0.129	1.76	4.04	0.46
S2	1.52	2.74	0.128	1.72	3.78	0.52
S3	1.88	2.75	0.131	1.94	3.49	0.47
Significance1/	*	N.S.	N.S.	***	***	***

1/ For explanation of symbols, see Table 1 and text.

considerable importance for several reasons.

In the first place, the effect of applied potash on cold hardiness as experienced, both here and in young Valencia orange trees in sand culture (no data shown), is contrary to a long-established belief that extra potash hardened twigs and foliage (1). It seems reasonably certain that this latter concept developed from observations many years ago when the crude potash sources contained considerable magnesium as an impurity. Thus, with Florida soils that are notoriously responsive to magnesium fertilization, it is not difficult to see how potash was erroneously credited with reducing winter injury. In retrospect, there is little doubt that foliage density, tree vigor and cold tolerance were all improved by the incidental magnesium contamination. Magnesium deficiency has been shown to increase greatly the susceptibility of citrus to cold injury (2).

In the second place, a slight increase in cold tolerance often makes a vast difference under marginal killing conditions. Most competent observers are of the opinion that the trees in Florida, as a whole, suffered less from last winter's colds than they should have if one judges by past experience. It seems that it is more than coincidental that, industry wide, the trees contained more nitrogen and less potassium than at any previous time and also had less magnesium deficiency. The fertilizer recommendations of the past few years have resulted in a 25- to 40-percent reduction in the amount of leaf potassium as compared with earlier recommendations. Leaf nitrogen content has increased and the leaf-magnesium status has increased so much that "bronzing" deficiency patterns are so scarce that they are an oddity. It is not possible, of course, to assign specific responsibilities on the basis of general observations, but there is little doubt that the modern improved balance among nitrogen, potassium, and magnesium within the tree contributed greatly to its cold tolerance from the practical standpoint.

Lastly, the positive relation of potash level to increased cold-damage susceptibility of field trees and the positive relation of nitrogen level to cold-damage tolerance are of particular interest to the senior author in that such relations were predicted several years ago (7) on the basis of the effect of these elements on the water content of tree tissues. Leaves high in potassium, for instance, were found to contain about 8 percent more water than leaves fairly low in potassium. Water content of plant tissues has been known to be a factor in freeze injury of plants. There were numerous instances in last winter's freezes of trees slightly wilted suffering less than turgid trees.

TABLE 3. EFFECT OF POTASSIUM LEVEL ON COLD DAMAGE TO 16-YEAR-OLD MARSH GRAPEFRUIT TREES ON ROUGH LEMON STOCK

Lb. K_2O Per Tree	Cold Damage Score	Dry leaf composition (%) N	P	K	Ca	Mg
0.5	1.23	2.93	0.096	0.43	4.94	0.66
2.0	1.41	2.82	0.101	1.08	4.51	0.55
5.0	1.58	2.85	0.108	1.71	3.52	0.63
Significance1/	*	N.S.	**	***	***	N.S.

1/ For explanation of symbols, see Table 1 and text.

Heavy-metals rates.—Three elaborate factorial experiments in which copper, zinc, and manganese at different rates were worked into the soil of young Valencia orange groves in 1954 are situated in the vicinities of Minneola and Groveland. Over 350 separate plots of trees are involved. Nearly all these 5- and 6-year-old trees were heavily defoliated and showed some twig damage from cold. Leaf samples taken in 1956 showed ranges in heavy-metal concentrations as follows: Cu 5 to 18, Zn 20 to 150, and Mn 26 to 375 p.p.m. in the leaf dry matter. None of these are considered to represent deficient or toxic levels. There was no suggestion, however, in the damage ratings that any given level of any of these metals had any effect on the degree of cold injury. For this reason no data on the ratings are given except that the overall mean score was 3.2.

TABLE 4. COLD DAMAGE RATINGS OF ONE AND TWO-YEAR-OLD TREES IN PASCO COUNTY AND ONE-YEAR-OLD TREES IN LAKE COUNTY IN RELATION TO CERTAIN FERTILIZER TREATMENTS

Treatment	Pasco County 1956-57	Pasco County 1957-58	Lake County 1957-58
C1	3.0 d	7.8 e	9.0 e
C2	2.0	7.3	8.2
C3	2.0 e	7.6 e	7.7 e
C3-12W	1.4 d	7.5 e	6.8 d
N1	3.3 dd	8.2 de	8.5 ed
N2	4.3 d	8.2 d	7.3 e
N3	4.8 de	8.4 de	4.8 dd
N3-12W	2.9 dd	8.2 de	6.6 dd
N2-PO_4	1.6 ed	8.0 ee	-
Significance	***	*	*

First letter following number denotes significant difference (d) from or equal (e) to standard C2 treatment; second letter denotes same relation to N2 treatment. For explanation of other symbols, see Table 1 and text.

Young-tree Fertilizer Tests. — Several hundred field plots of 4 or 5 trees each are under trial in Lake and Pasco Counties in an attempt to find out the optimal way to fertilize young trees for the first 2 or 3 years in the field. The range of treatments, about 90 in all, is too elaborate for detailed description here. Only a few selected treatments will be discussed to illustrate the general relation of fertilization to cold injury of young trees. In both locations a complete mixed fertilizer equivalent to 6-6-6-2-½-½-½-1/10 (N, P_2O_5, K_2O, MgO, CuO, ZnO, MnO, and W_2O_3) is applied every 6 weeks during the growing season at rates of 0.25 pound (C1), 0.5 pound (C2), and 1 pound (C3). In another treatment 1 pound of the mixture is applied every 12 weeks (C3-12W). In other treatments ammonium nitrate alone is applied in amounts equal to the N in the above mixed-fertilizer rates. These treatments are identified as N1, N2, N3, and N3-12W. The C3-12W and N3-12W plots received their last fertilization for the year in late August, whereas all other plots were fertilized in October. Ammonium nitrate plus superphosphate (N2-PO_4) comprised one treatment in Pasco County, where the light sand was very low in native phosphorus.

The results of cold injury to the trees in the Pasco experiment from a freeze on November 28, 1956, along with the recent winter's cold damage at both locations, are included in Table 4. In the Pasco location on Lakewood sand, all trees receiving PO_4 either in the mixed fertilizer or separately grew markedly faster than those without, so that there was a large size differential both years and the smaller trees were more damaged than the larger ones. In Lake County, on Lakeland fine sand, the tree size and extent of cold injury were similar with mixed fertilizer or nitrogen alone except for the high rate of ammonium nitrate where the trees showed markedly less cold injury than all other treatments. The reason is not entirely clear. It is clearly evident at both locations that there were less cold injury of first-year trees when the last fertilization was made in August than when it was made in October. This can be judged by comparing C3-12W with C2 and N3-12W with N2. The amount of mixed fertilizer or ammonium ni-

(Continued on page 18)

Weed Control In Citrus Planting Sites...

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Much of the new grove acreage planted in recent years has been on sites that were formerly pastures. It was pointed out by Simanton and King (1) that considerable trouble has been experienced with the pasture grasses in caring for the young grove once the trees are set. Where ground cover cannot be readily suppressed when desired by usual grove cultivation, it can present a fire hazard, cause a rough surface that impedes grove equipment, intensify cold damage, and generally retard normal growth of trees. The trouble, expense, extra labor, and tree competition that has occurred in groves with an excessive weed problem is such that growers would be well advised to eliminate as far as possible these potential weed pests before planting the first tree. A grove is a long time investment; thus elimination of pest weeds may justify a substantial expense as part of the initial development cost.

Pasture grasses known to give trouble include bermuda (**Cynodon dactylon** (L.) Pers.), pangola (**Digitaria decumbens** Stent.), bahia (**Paspalum notatum** Flugge), para (**Panicum purpurascens** Raddi), guinea (**P. maximum** Jacq.), maidencane (**P. hemitomon** Schult.), and torpedo (**P. repens** L.), although these are by no means all of the pest species. In the coastal areas, para, guinea and bermuda grasses are likely to be troublesome, but on the ridge, pangola, bahia, and bermuda are often the problem. Maidencane, although not a planted pasture grass, is also a common grove pest. Torpedograss has been widely planted for pasture and in some areas it has become a particularly serious problem where the land is to be cultivated.

Maidencane and torpedo produce rhizomes which can extend laterally underground for several yards. Where torpedo is established, aggressive pencil-thick rhizomes bearing tuber-like swellings may be found 6 to 12 inches below the soil surface. Viable rhizomes are known to exist

DR. SIMANTON

even though all topgrowth has been suppressed for as long as six months. The grass competes severely with young citrus trees, and if the grove does become established it is likely to be less vigorous and require considerably more fertilizer, water and care than a non-infested grove. Until a method is found to eradicate torpedo or control it effectively, lands infested with this grass should not be used for citrus planting sites.

If pasture woodlands, forest lands and hammocks are to be cleared for citrus groves, numerous plant species including vines, brambles, scrub oak, palmetto, and various root sprouts and bushes are likely to be troublesome weeds for a year or two after clearing. Generally the grass, broadleaf and woody weed problems can be brought under control by correct use of tillage in conjunction with herbicidal chemicals.

Tillage Methods for Control

In discussing chemical weed control in planting sites, probably as much attention should be given to tillage methods as to the chemicals because tillage is a necessary part of the land preparation and must be done in all cases. The right type of tillage at the right time will aid greatly in controlling potentially troublesome weeds at very little additional cost. Timing of the tillage is particularly important because if it is done during a dry period a large degree of weed control can be expected, whereas during a wet period it often not only fails to control weeds but in some cases actually stimulates their growth.

Moldboard and disk plows that penetrate 8 to 10 inches deep and turn the furrow completely are particularly effective against sod-forming grasses such as bermuda and pangola when used during dry weather. Deep disking with a bush and bog harrow is not as effective as plowing for the initial step in destroying a sod but is of value for subsequent breakdown of sod. Deep disking or plowing will often stimulate maidencane and torpedograss to vigorous top growth because it cuts through the rhizomes. Grove disks with depth rings that permit only shallow penetration generally do little harm to establish pest grasses but may be useful in knocking down excessive top growth in preparation for spraying.

Chemical methods are best used in conjunction with tillage and are about the only effective methods that can be used when wet weather prevails. The herbicide should be inexpensive enough to be used on large acreages, be highly effective against the pest weeds present, and be free of prolonged phytotoxic action that would harm young citrus trees planted later. The most useful herbicides in this category are systemic materials that are taken in through the leaves of the plants and translocated to the crown and throughout the root system. Such materials are also taken up to a certain extent directly from the soil by the roots.

Dalapon is one of the most effective grass killers of a systemic temporary type. It is marketed as a branded product "Dowpon" which contains 85 percent of the sodium salt of dalapon equivalent to 74 percent of dalapon acid. Present cost of the product is about $1.15 per pound. It is a readily soluble powder with a low toxicity to man and animals. The herbicidal action usually begins three weeks after the first treatment and reaches a maximum at four to six weeks. If the plant has not been killed within eight weeks, normal growth resumes. Best results are obtained with dalapon if it is applied when the top growth is reasonably vigorous and sufficiently abundant that the material will

[1]Florida Agricultural Experiment Station. Journal Series No. 832. Presented at Annual Meeting of Fla. State Hort. Soc. in Clearwater, October, 1958.

be taken up in quantity and translocated to the roots.

Good kills have resulted from the application of 5 to 10 pounds of commercial material per acre, followed one to two weeks later, and before the grass turns brown, by a second application at similar rates. A more thorough kill results from two applications applied at a two-week interval than from a single application of the same total quantity of chemical. Two treatments usually burn down all top growth. If any reappears a month or two later, it can be spot sprayed with a solution of 0.1 pound dalapon per gallon of water

Phenoxy herbicides, another group of weed killers, are inexpensive, highly effective systemic herbicides for broadleaf and woody weeds. Several brands sold as brush killers contain 4 pounds per gallon of the active acid ingredient, 2,4,5-trichlorophenoxy acetic acid, or mixtures of 2,4,5-T with 2,4-D. 2,4,5-T is more effective than 2,4-D against vines, scrub and sprouts usually encountered in planting-site preparation. The amine form is preferred because of its low drift hazard and its relatively short residual effect. Two to four pounds per acre of amine salt may be used alone or mixed in the spray tank with dalapon. These two herbicides are compatible chemically and physiologically with respect to the weed growth conditions necessary for good results against a broad range of plant species.

Among other herbicides of value for grass control is sodium trichloroacetate, which is commercially available as a 90 percent soluble salt equivalent to 79.3 percent of trichloroacetic acid (TCA). Cost is about 45 cents per pound for the 90 percent salt. TCA has been used as a grass killer since 1948. Rates approximating 70 pounds per acre are suggested for killing established sods, preferably sprayed soon after deep tillage. The action is mainly through the roots and for satisfactory kill sufficient rainfall is necessary to carry the herbicide to the root zone. The herbicidal effect of TCA in the soil diminishes rapidly as additional rainfall leaches the chemical below the root zone. TCA is more expensive than dalapon and has not given as reliable control where soil moisture was not optimum.

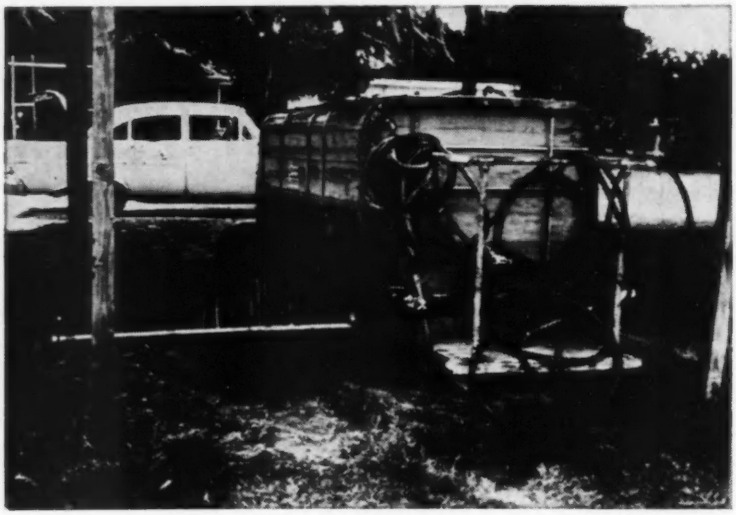

Figure 1.—Grove sprayer converted for applying dalapon herbicide. The horizontal boom with fan nozzles is mounted close behind the wheels to maintain constant height above the soil surface.

Diuron is another herbicide of interest for weed control in citrus groves. It is marketed as Karmex DW which contains 80 percent of active diuron in wettable powder form. Cost is about $3.70 per pound. Diuron is a long-effect herbicide with semi-soil sterilant action against a wide range of weeds. Used alone it is not sufficiently effective against grasses to be economical for planting site use. Although diuron may maintain herbicidal action in the soil for several months, citrus trees tolerate this chemical well and replant trees have been observed to grow well when planted five months after a 30-pound-per-acre treatment.

The combination of diuron and dalapon has proved to be highly effective against pangolagrass in experiments at two different locations in Florida. Two applications at two-week intervals of a spray mixture containing 5 pounds of commercial dalapon and 5 pounds of commercial diuron per acre were far more effective than either material used alone. This was one of the best treatments found. Although this combination is expensive, it may have some advantage as a spot spray where weeds are particularly difficult to control and a lasting suppression of all weeds is desired.

Conditions for Herbicide Application

Since both the dalapon grass killer and the phenoxy compounds used for broadleaf and woody weed control

(Continued on page 18)

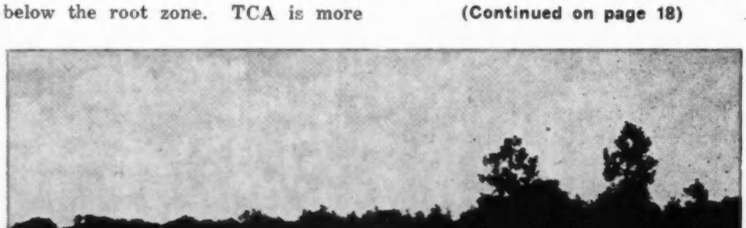

Figure 2.—Plowing under pangola grass sod during a dry December resulted in 95 percent kill of grass by the following March. An experimental herbicidal barrier strip to retard grass encroachment from the adjoining pasture runs along the fence.

CITRUS INSECT CONTROL FOR SPRING 1959

(Continued from page 3)

"Would it be a good idea to omit the post-bloom scalicide and if necessary, apply a second scalicide in the Fall? This would save the cost of one scalicide if two are not needed." The answer to this question is "No" because, although a Fall scalicide may kill scale just as effectively as one applied post-bloom, it is much too late to prevent scale damage to fruit, foliage, and wood. Even though a second scalicide is applied in September, after the fruit is infested, green spots caused by scale will not degreen, but will remain to markedly lower the grade. This is the reason why post-bloom and summer scalicides are especially important every year on Temples, tangerines, and other varieties grown for the fresh fruit market. In 1959, when scales are expected to be a severe problem the omission of a post-bloom scalicide may result in leaf drop, dead wood, and fruit drop as well as green spots before a second application can be made in September or October.

There are several scalicides and combinations of scalicides that can be used. Each one has its advantages and disadvantages. Parathion and malathion are both very effective and much safer than oil as far as the trees are concerned. They are not as likely to cause leaf drop or drop of young fruit as oil and may be used with neutral compounds of copper, zinc, and manganese as well as borax and lead or basic copper arsenate. Neither parathion nor malathion will control spider mites or rust mite, but both may be used with any of the materials that are effective against these mites. Use O.15 to 0.25 pound of technical parathion per 100 gallons or 0.75 to 1.25 pound of technical malathion. Where fruit is present do not apply parathion within 14 days of harvest or malathion within 7 days of harvest.

Oil emulsion containing 1.3% actual oil is a very effective scalacide and will also control red spiders, but may cause severe leaf drop and drop of young fruit during dry weather or when there is a wind with low humidity. Neutral copper compounds may be used with oil emulsion, but some copper compounds may cause flocculation which results in fruit burn, leaf drop and poor control of melanose. No more than one metallic compound should be used with oil emulsion except that lead arsenate may be added to mixtures of copper and oil on grapefruit. Mixtures of copper and zinc or copper, zinc and manganese are very likely to break an oil emulsion or cause blemish on fruit even when the mixture is stable.

Two scalicidal mixtures are also satisfactory for post-bloom use. These are —0.7% actual oil with either 0.15 pound of technical parathion per 100 gallons or with 0.5 to 0.75 pound of technical malathion. The oil-parathion mixture may cause as much or more injury as 1.3% oil, but the oil-malathion mixture has been less harmful.

No more than one oil spray should be used during any crop year whether 0.7 or 1.3% oil is used and regardless of the dates of application. For this reason oil is recommended for post-bloom use only where parathion or malathion are to be used in subsequent sprays. Furthermore, oil is not recommended when the average size of fruit is between 0.75 and 1.25 inches in diameter because it will blotch fruit in this size range.

If a mealybug infestation develops, apply either 0.25 pound technical parathion or 0.75 to 1.25 pounds of technical malathion per 100 gallons. These materials in the combination with oil are also effective. The application should be made before the calyx fits close to the fruit so that the spray will come in contact with the mealybugs. Make a thorough application on leaves, fruit, trunk and limbs. The mealybug spray can be combined with the regular post-bloom copper spray for melanose.

Melanose Control: The best control of melanose is obtained when copper sprays are applied from one to three weeks after the petals have dropped. However, where large acreages are involved, it is best to start applying copper as soon as the petals have fallen. Use enough neutral copper compound to supply 0.75 pound of metallic copper per 100 gallons. Do not use any copper compound with lime-sulfur because such mixtures are often very injurious.

Scab Control: Two applications of copper are needed to control scab on susceptible varieties such as Temples, tangelos and occasionally grapefruit. The first application should have been made in January and the second should be made when 2/3 of the petals have dropped. If scab is of primary importance and no copper was applied in January, apply a copper spray as soon as possible. Where scab is not a severe problem the dormant copper spray may be omitted or the second may be delayed until after the petals have dropped to also control melanose. Post-bloom copper sprays will control greasy spot on the spring growth.

Rust Mite Control: Five materials are now available for post-bloom control of citrus rust mite. These in decreasing order of effectiveness are zineb at 0.5 to 1.0 pound per 100 gallons, Chlorobenzilate at 0.5 pint or 0.5 pound, 1.0 gallon of lime-sulfur plus 5.0 pounds of wettable sulfur, 10 pounds of wettable sulfur and Trithion at 0.5 pint or 1.0 pound.

The longest periods of rust mite control are obtained with all materials when sprays are applied thoroughly enough to wet all fruit and leaf surfaces and applied before the population attains a high level. This is called preventative spraying and is the only way to obtain the longest control per dollar spent. When used in this way, both zineb and to a lesser extent, Chlorobenzilate, should give adequate rust mite control until about July 1. The others are likely to need respraying in May or June.

All of the copper compounds used on citrus reduce the effectiveness of zineb. However, this deficiency can be overcome somewhat by increasing the dosage of zineb from 0.5 to 1.0 pound per 100 gallons. Although the higher dosage of zineb plus copper is significantly more effective than either 0.5 pound of zineb plus copper or wettable sulfur, it is not as good as 0.5 pound of zineb without copper. Mixtures of zineb and copper have given long-lasting control of rust mite where rust mite was absent or very difficult to find. On the other hand, failures have resulted when rust mite was very numerous at the time of application. Therefore, zineb is highly recommended for post-bloom use at 0.5 pound per 100 gallons except where copper is used. If copper is used, the dosage of zineb should be increased to 1.0 pound, but this mixture of zineb and copper should not be used where rust mite is numerous. Where zineb cannot be used, second and third choices are Chlorobenzilate and sulfur sprays. Do not use lime-sulfur on tangerines. Trithion should be used only where combined control of rust mite and red spiders is desired. If rust mite becomes a problem between the post-bloom and

summer sprays, sulfur dusts or sprays should be used.

Broad Mite Control: The broad mite occurs in some groves in some years and causes a russet similar to the russet caused by rust mite. Broad mite is a spring problem, occurring on small fruit up to about an inch in diameter. It is not present every year, but when it does occur, it is confined to groves on low land or adjoining moist areas. Sulfur should be used in groves that have a history of broad mite injury because zineb does not control this mite.

Red Spider Control: Purple mite and to a lesser extent, Texas citrus mite will be numerous during the post-bloom period with maximum populations in May and June. This outbreak can be prevented in most groves by the use of oil emulsion or Tedion (Tedion should not be used on fruit of any size) in the post-bloom spray. Other miticides such as Systox, Kelthane, or Trithion cannot be expected to last from post-bloom until time to apply the summer scalicide. Unless oil or Tedion can be used, it is not currently practical to attempt purple mite control with a post-bloom spray unless soil moisture is extremely low. Although uncontrolled purple and Texas citrus mite feeding will severely dull citrus foliage, it will rarely cause a leaf drop at this time of the year in healthy groves as long as soil moisture is good.

Six-spotted mite may become injurious in a few groves. This mite may be controlled with materials used for purple mite, but more thorough coverage is needed for satisfactory results.

Recommended Post-Bloom Spray Programs: The best control of citrus pests is obtained by using sprays that are designed for the problems of each individual grove and then applied at the best time. Many owners of small acreages do not have resources to carry out such a program. For those who are in this position, the following simplified sprays are suggested for use after bloom.

Parathion 15W, 1.7 pound/100 gallon

Zineb, ½ pound

or

Parathion 15W, 1.7 pound/100 gallon

Neutral Copper (0.75 pound metallic copper)

Wettable Sulfur, 10 pounds

Details of spray schedules and the various materials used will be found in the "Better Fruit Program" and this should be consulted to determine which materials may or may not be combined. For further information, consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

Spreading Decline Check Shows Nematode Damage Still Exists

Although the control program for spreading decline in citrus remains sidetracked by court order, state and federal officials are continuing to keep a close watch on the burrowing nematode responsible for decline.

This is clearly evident in figures that reveal the collection of 3,289 root samples during November from trees and plants in suspect citrus groves and nurseries. Of this total, 157 samples proved positive. Thus for the three years in which the push-and-treat program has been in operation, State Plant Board and U. S. Department of Agriculture personel have collected and examined 507,179 root samples and found 28,729 to be infested with the burrowing nematode.

The November figures disclose that 26 groves and 67 nurseries were checked for the first time. Seven of the groves and three of the nurseries were positive.

Since push-and-treat activity now is limited to margins of properties previously treated, little has been accomplished in the months following a court injunction which halted the program on a compulsory basis. The Plant Board nevertheless treated 15 acres of citrus during the past month and either destroyed or declared out-of-business seven infested citrus nurseries.

In the three years of operation, the Plant Board now has pushed and treated 4,750 acres of citrus, slightly more than half the acreage estimated to be infested with spreading decline.

Of 4,787 citrus nurseries inspected to date, 290 were found with nematode infestations. Since 187 have been destroyed or quarantined, 103 remain to be treated. A further breakdown shows that 74 of these infested nurseries are commercial producers.

Polk County continues to lead the list with 392 properties and 3,073 acres treated. Highlands is next with 104 properties and 1,117 acres, followed by Lake with 47 properties and 252 acres, and Orange with 23 properties and 134 acres.

The spreading decline problem returned to the news recently with the declaration of a group of citrus men that a new program for control should be readied for the next legislature. The group has asked the State Plant Board for figures and information that might be utilized in the formation of an acceptable program.

ZINEB SPRAYS CHECK AZALEA FLOWER SPOT

Be prepared to prevent azalea flower spot from ravaging your blossoms, says Dr. H. N. Miller, plant pathologist with the Florida Agricultural Experiment Stations.

If the fungus hits, it can wilt a magnificent display of azalea blossoms in 24 hours and dry them up in afew days. The disease first shows up as water-soaked spots on the petals, turing the flowers into a slimy mush.

Dr. Miller says flower spot can be controlled by spraying when the early azaleas start blooming and repeating the spray three times a week throughout the flowering season. He recommends using a spray mixture of 1½ tablespoons of 65 percent zineb per gallon of water.


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Potash Relationships In Commercial Groves

A. E. WILLSON AND W. J. AREY
MINUTE MAID CORPORATION, PLYMOUTH, FLORIDA
PRESENTED AT FLORIDA STATE HORTICULTURAL SOCIETY IN OCTOBER, 1958

Introduction

Research by Federal and State agencies in Florida (6,7) has emphasized the importance of avoiding excessive potash in the production of high solids oranges. The value of having fruit with high solids for frozen concentrate is being emphasized more and more by the processing industry.

The appearance of occasional symptoms can be used as a warning of approaching deficient levels of nutritional elements. At this stage steps can usually be taken to correct the condition before any damage occurs. Early symptoms of potash deficiency are not clearly defined and their use for fertilizer control is not very dependable.

Tissue analysis has been used for some time as a guide for the fertilization of other crops and potash leaf analysis has been recommended as a guide for fertilizing citrus in California (1). We have been able to measure the precision of a leaf sampling procedure in Florida groves and have shown that it should be adequate for developing potash fertilizer control methods (8).

The development of control methods is a lengthy process which must be based on experience obtained over a period of years. This work should show how dependable the leaf sampling procedure is as an index to the potash nutritional status of citrus groves. It should also include a study of the variability of the data in relation to fruit quality and yields so that control limits can be properly defined. The following paper is a progress report of work along these lines which has been based on surveys and controlled experiments.

Methods and Results

Survey Studies—Surveys have been made in Minute Maid groves over a period of seven years to study the experimentally demonstrated relationships (6) (7) between leaf potash and fruit quality. About 200 groves were sampled each year and a Beckman Model D-U Flame Spectrophotometer was used for the potash determination. Fruit size distribution estimates were used as the only index to fruit quality (6) (2) in years when there was a shortage of help.

One hundred fruit per grove were measured in a random sample pattern similar to that used for leaves (8). The percent distribution of fruit into three size groups was recorded each year in groves selected for a wide range of leaf potash content. The °Brix and percent acid were determined in groves used for special studies. In some years it was possible to complete more than one correlation study between leaf potash and fruit quality characteristics. Results of this work have been summarized in Table I to indicate the years when correlations were or were not significant.

Table I

Years When Statistically Significant (1) Correlations Were Obtained in Commercial Groves

Crop Year	Leaf Potash vs. Fruit Size	Leaf Potash vs. °Brix	Leaf Potash vs. %Acid
1951-52	Yes	No	Yes
1952-53	Yes	No	No
1953-54	Yes	Yes	No
1954-55	No	No	No
1955-56	Yes	No	Yes
1956-57	No		
1957-58	No		

(1) Correlation coefficients at the 5% level or better were considered significant.

In the 1953-54 crop there was an opportunity to calculate the average values from the State tests for all fruit arriving at our plants from Minute Maid groves during one month periods in the Pineapple and Valencia seasons. From this work it was possible to obtain 26 pineapple and 35 Valencia groves for correlation studies. Figure I shows the relationships between leaf potash and small fruit and Figure II shows the relationships between leaf potash and fruit solids.

It was calculated from the data for Figure II that the solids in one sixty acre block of Valencias should be increased by 8900 pounds, if the solids of the fruit could be raised to the average of the 35 groves, by lowering the leaf potash level to the 35 grove average. This work was most encouraging since it was in agreement with published research findings (6,7). Since the 1953-54 season we have not had an opportunity to make such an extensive study of the leaf potassium-fruit solids relationships. The more limited work, which was conducted in groves which were also studied for other problems, did not show such significance.

The potash values for the same age leaves were found to vary in an unpredictable manner from year to year. In the 1956 season leaf potash values were generally lower than in previous years and in several groves there were values less than 1.0% in 6 to 7 month all spring flush leaves. Although no increase was made in the potash fertilizer, leaf potassium values showed an increase the next year. Groves which had less than 1.0% in 1956 had values which ranged from 1.2 to 1.5% in 1957.

The surveys included widely separated groves with potash fertilizer ranging from 90 to 250 pounds per acre. These groves had been receiving potash regularly and were all within a range of adequate supply as far as the absence of deficiency symptoms was concerned. Practically all of the leaf potassium values ranged between one and two percent during the seven years of the study.

Under these conditions no relation was found between the potash content of the leaves and the potash applied even when the fertilizer for more than one year was included in the study. The variation in potash utilization is also demonstrated in the potash experiment in the next section where experimental groves receiving the same potash fertilizer over a period of three years had widely different leaf potassium values.

Potash Fertilizer Experiment

The leaf sampling procedure was used to follow the development of potash deficiency in several 25 to 30 year old Pineapple and Valencia groves on rough lemon stock. Plots of 2 to 5 acres each, which received

Continued on page 16)

POTASH RELATIONSHIPS IN COMMERCIAL GROVES

(Continued from page 14)

no potash for a period of three years, were located in different groves in Polk County. These zero potash plots were paired with adjoining plots of comparable trees which received potash each year in decreasing amounts as shown in Table II. There were five pairs of Pineapple plots and six pairs of Valencia plots in this survey.

Table 2

Pounds of Fertilizer Used Per Tree Per Year for Valencia and Pineapple Blocks (1)

Year	Nitrogen	Potash	Magnesium
1954-55	4.6	3.8	2.3
1955-56	4.3	2.2	1.9
1956-57	3.5	1.8	0.0

(1) The zero potash plots received the amounts of nitrogen and magnesium shown in this table.

Three years after the start of the experiment, the zero potash plcts had much less cover crop than the neighboring plots receiving potash. General tree condition was good and was about the same in the two sets of plots. The zero potash plot, which had the lowest potassium (0.62%) in randomly sampled seven month old leaves, probably had a few trees which were starting to show evidences of potash deficiency.

One or two branches dropped a large number of leaves while the rest of the tree appeared to have relatively little leaf drop. These weak branches had small yellow cast leaves with occasional burnt tips and bore exceptionally small fruit, which tended to break color early. Leaves from these branches sampled in October had a potassium content of 0.25%, while four comparable leaf samples from non-fruiting twigs on apparently healthy branches ranged from 0.40 to 0.51%.

Random fruit size distributions were measured twice in the fall of 1957 and were about the same for the two sets of plots. The average size distribution data for the Pineapple plots during the course of the experiment are given in Table 3. The small differences between treatments were not significant. Similar results were obtained for Valencia. The exceptionally small sizes observed in some of the zero potash plots indicated that a significant relation would probably have been obtained if smaller sizes had been measured in the distribution studies.

Table 3

Percent Size Distributions in Pineapple — Orange Plots

Year	Size	Potash Plots	No Potash Plots
1954-55	Large	5.8	4.0
	Medium	61.0	63.5
	Small	33.2	32.5
1955-56	Large	9.0	3.2
	Medium	81.8	84.5
	Small	9.2	12.3
1956-57	Large	0.5	0.0
	Medium	53.3	45.0
	Small	46.2	55.0
1957-58	Large	11.5	8.2
	Medium	50.0	52.5
	Small	38.5	39.3

Sizes:- Large 150 & larger
Medium 176 - 216
Small 250 & smaller

Yields were approximately the same in the 1955-56 and 1956-57 seasons. Both the Pineapple and Valencia crops were so badly injured by the freeze that accurate yield data could not be obtained in the 1957-58 season. Before the freeze, both sets of plots appeared to have good crops of fruit.

In the fall of 1957 heavy fruit drop was noted in many groves throughout the State. This condition was not confined to any particular location or grove. The potash plots provided an excellent opportunity to check the effects of low potash nutrition on fruit drops. A simple scoring system was developed so that both the total fruit dropped and the amount of split fruit could be quickly rated. A summary of the results of this scoring, along with leaf analysis data are given in Table 4.

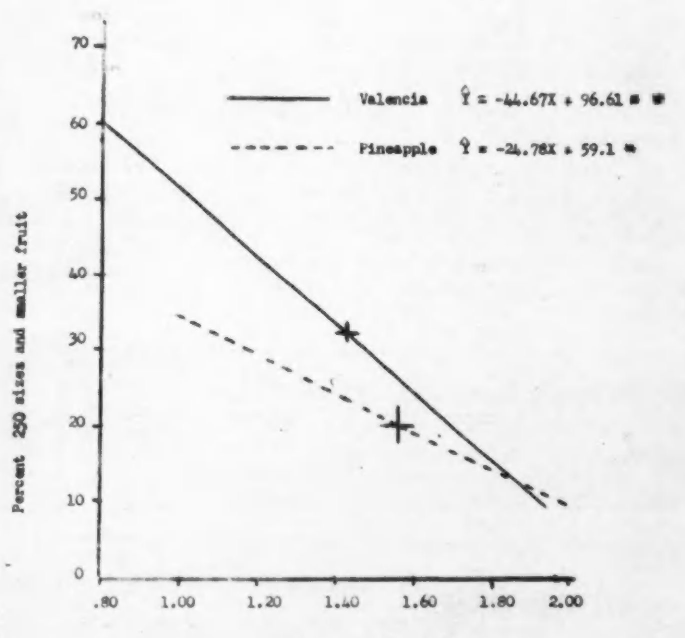
Pineapple drops were fruit with "physiological breakdown" characterized by a premature color break at the styler end and a progressive collapse of the peel which developed into a brown spot and finally ruptured to allow the entrance of disease organisms. There were very few split Pineapple fruit while practically all of the Valencia drops were split fruit.

The plots were scored for dropped fruit on October 15, 1957 and the

(Continued on page 21)

FIGURE I

RELATIONSHIP BETWEEN THE NUMBER OF SMALL VALENCIA AND PINEAPPLE FRUIT SIZES AND LEAF POTASSIUM LEVELS IN MINUTE MAID GROVES.



** and * - Correlation coefficients significant at the 1.0% and 5.0% levels respectively.

RELATION OF FERTILIZATION TO WINTER INJURY TO CITRUS TREES

(Continued from page 7)

trate in these respective comparisons is equal for the year. In the absence of phosphorous deficiency, a tendency toward less cold injury was evident in first-year trees at the higher rates of mixed fertilizer or nitrogen. This is not related to tree size as tree-size measurements indicated no difference due to rates. These results seem to corroborate the observations described above in which high nitrogen increased the cold tolerance of bearing-sized trees.

In the case of the 1957-58 damage to 2-year-old trees in the Pasco County experiment, tree size was the only thing that appeared to have a bearing. The trees were nearly all very severely frozen, being killed into the banks. The trees that depended on the soil for phosphorus were considerably smaller than those supplied with fertilizer phosphorus and were injured slightly more. Rates and timing had no effect.

All the observations reported here indicate that fertilization practices have a relatively small effect on cold tolerance of citrus when obvious deficiencies are absent. In general, they support the conclusion drawn by Lawless (2) after the 1940 freeze that "there is no magical virtue in any single element" insofar as imparting cold protection to the tree. Fertilization practices that produce a healthy, vigorous tree seem to offer about the maximum protection that can be attained within the tree. However, it seems probable that shifts in fertilization practices in recent years resulting in more nitrogen and less potassium within the trees and a total disappearance of magnesium deficiency played a positive role in the "less than expected" degree of damage from one of the severest winters in Florida's history. Other factors, such as the drought-induced dormancy prior to the severe December cold and the prevailing cool weather that delayed the advent of new growth between potentially damaging freezes, no doubt had a large part in reducing over-all damage.

SUMMARY

Visual ratings of the degree of damage were made on trees in about 1,000 fertilizer plots in Orange, Lake, and Pasco Counties following the freezes of 1956-57 and 1957-58. Low temperatures ranged from 18 to 22 degrees in Pasco County both seasons and in the other counties in the latter season. For the most part, damage to bearing trees in the experiments ranged from none to some degree of defoliation and slight twig damage. Young-tree damage ranged from moderate defoliation to the killing of the entire top down into the protective soil bank around the trunk.

In general, nutrient status of the trees above deficiency levels had but slight effect on cold tolerance. High rates of nitrogen fertilization had a small but definite tendency to increase the resistance of the tree to freeze injury. High rates of potash had a small but definite tendency to reduce the cold resistance of the tree. Differential supplies of phosphorus, copper, zinc, and manganese had no effect on the degree of freeze injury sustained.

Young trees, the first year in the field were appreciably less injured when the last fertilizer application of the season was made in late August than when the trees were fed again in October. Such an effect was not apparent on 2-year-old trees. Young trees, stunted for lack of phosphorus on Lakewood sand, were more severely damaged in each of 2 years than trees adequately supplied with phosphorus.

LITERATURE CITED

1 Rume, H. H. The Cultivation of Citrus Fruits. MacMillan Press. New York. 1926. Also, Citrus Fruits. MacMillan Press. New York. 1956.

2. Lawless, W. W. Effect of freeze damage on citrus trees and fruit in relation to grove practices. Proc. Fla. State Hort. Soc. 54: 67-74. 1941.

3. Lawless, W. W. and A. F. Camp. Preliminary reports on varieties, fertilizers and other factors as influencing cold resistance in citrus. Proc. Fla. State Hort. Soc. 53: 120-125. 1940.

4. Reuther, W., P. F. Smith, G. K. Soudder, Jr., and G. Hrnciar. to timing, rates, and ratios of nitrogen fertilization. Proc. Amer. Soc. Hort. Sci. 70: 223-236. 1957.

5. Smith, P. F. Effect of phosphate fertilization on root growth, soil pH, and chemical consistituents at different depths in an acid, sandy soil. Proc. Fla. State Hort Soc. 69: 25-29. 1956.

6. Smith, P. F. and W. Reuther. Preliminary report on the effect of nitrogen source and rate and lime level on pH, root growth, and soil constituents in a Marsh grapefruit grove. Proc. Fla. Soil Sci. Soc. 15: 108-116. 1955.

7. Smith, P. F., W. Reuther, and G. K. Scudder, Jr. Effect of differential supplies of nitrogen, potassium, and magnesium on growth and fruiting of young Valencia orange trees in sand culture. Proc. Amer. Soc. Hort. Sci. 61: 38-48. 1953.

WEED CONTROL IN CITRUS PLANNING SITES

(Continued from page 10)

are systemic herbicides, best results are obtained if the following points are kept in mind:

1. Surface weed growth should be vigorous for good uptake of herbicide. If large clumps of weeds are present or a dense mat exists, it is advisable to mow or otherwise reduce this old heavy growth three weeks before spraying so that better penetration and coverage of tender growth will result.

2. Spray coverage should be such that surface growth is well covered without excessive runoff. Spraying should be scheduled when rain is not likely to occur for at least four hours after treatment.

3. A second spraying should be made one to two weeks after the first and before the weeds turn brown. This permits more translocation and results in a more thorough kill. It is advisable to spray in one direction for the first application and in a cross direction for

the second to avoid the possibility of skips.

4. Subsequent tillage is desirable to weaken the weeds further but should be delayed for two to four weeks after the vegetation turns brown to permit full chemical kill.

Spraying Equipment

Herbicides of the type described may be applied by hand sprayers if only spot treatment is necessary, but if large acreages are involved it is preferable to obtain a rig especially designed to apply weed killers uniformly to the ground surface. Such sprayers are available from manufacturers of grove spraying equipment in tractor mounted or trailer types. Descriptions of weed sprayers and nozzles, including details concerning calibration and operation, are contained in Bulletin 532 of the Florida Agricultural Experiment Station (2).

Most weed sprayers have a boom mounted 18 to 20 inches above the soil surface on which nozzles are spaced at 20-inch intervals. A satisfactory nozzle for ground spraying is the fan type such as Tee Jet No. 8010. Weed sprayers are preferably operated at pressures of 50 to 100 pounds in order to produce a coarse spray which does not drift. With the boom and nozzle arrangement mentioned, and within the pressure range specified, approximately 100 gallons per acre is delivered at a travel speed of three miles per hour. Adequate coverage of top growth without excessive runoff usually requires 100 to 200 gallons of spray per acre. Delivery rates can be regulated by nozzle size, by pressure, or by doubling the number of nozzles.

Ordinary hydraulic grove sprayers have been converted at a reasonable cost into weed sprayers by mounting a boom on the underside of the sprayer frame immediately behind the wheels (Figure 1). A pressure gauge is attached to the boom and the regulator adjusted to approximately 50 pounds. Most grove sprayer pressure regulators can be turned down to this extent, but if not, a supplemental low pressure regulator can be connected in series with the high pressure regulator to further control delivery pressure. A quick-closing valve on the hose line leading to the boom enables immediate shut-off.

One problem in using systemic herbicides is that of avoiding contamination when the spray equipment is later used for applying insecticides and similar sprays to crops. Dalapon is a readily soluble material and if used in a steel tank there is very little danger that carryover toxicity to citrus will remain, provided the tank is thoroughly rinsed out, the pump started, and the nozzles opened so that all water in the tank, lines and air pressure chamber is replaced with fresh water two or three times. Dalapon has been used successfully in wood tank sprayers provided the tanks were in good condition and the interior had previously been coated with a suitable water-impervious primer and paint. It is best when cleaning a wood tank to fill it with clean water after the regular flushing and let it set for a day to allow any dalapon absorbed by the wood to dissolve in the water and be drained out.

Where phenoxy herbicides such as 2,4,5-T are used, a separate sprayer solely for weed work is recommended. As an alternative, steel tank equipment in good condition can be used, but the operator should be cautioned that thorough cleaning with an alkaline detergent solution several times, with several flushings of lines, nozzles and hoses will be necessary to

assure that the sprayer is safe to use for subsequent spraying of crops.

Diuron presents a different cleaning problem in that it has a tendency to deposit sludge on the strainers and scum in the tank. At rates below 20 pounds per 100 gallons, these residues are not likely to be a problem unless the mixture is allowed to remain in the tank for an extended period without good agitation.

Field Trials of Weed Control in Citrus Planting Sites

A combination of tillage plus dalapon herbicide treatment for pasture grass eradication has been effectively applied in two areas. In one 10-acre block near Haines City, a moldboard plow was used to turn the pangola sod 10 inches deep on December 15, 1956. That was during a cool, dry winter, and on March 13, 1957, 95 percent of the pangolagrass was dead. The 5 percent present was mainly where sod had not been turned under well at the corners of the field. On April 18, when regrowth started, the remaining grass was spot sprayed with 1 pound of commercial dalapon in 5 gallons of water. Treatment of regrowth by walking the field with a knapsack sprayer required one man-hour of time and 3 gallons of spray per acre. One month later, only a few sprigs of pangolagrass comprising less than 0.5 percent surface coverage remained. Figure 2 illustrates the control obtained.

Another planting site was a 38-acre pasture near Lake Alfred planted mainly to Pensacola bahia but it also had considerable maidencane and some pangola and bermuda. Plowing in November 1957, and subsequent winter fallow destroyed nearly all of the pangola and bermuda and much of the bahia. By April 3, 1958, the surface was 30 percent covered with bahia and maidencane regrowth from viable stems and rhizomes.

Nutgrass became abundant as it usually does when grass competition is suppressed. Dowpon at 7.5 pounds in 100 gallons of water per acre was applied on April 3 and again on April 13. By April 28, 50 percent of the madiencane and nutgrass and 90 percent of the bahia was dead and brown. Maximum effect from dalapon was reached about May 12, which was 40 days after the first application. Coverage on May 12 was 2 percent maidencane, 1 percent bahia, 30 percent broadleaf weeds, and 2 percent nutgrass. Thorough disking on June 12 reduced the remaining grass to less than 0.1 percent coverage. One month later, hairy indigo began to grow and by August it had covered 96 percent of the surface. Figure 3 shows the planting site on September 4, 1958. The indigo was not a planted crop and only an occasional indigo plant had been observed in the previous year.

Figure 3.—Tillage combined with dalapon sprays applied in April eliminated all grass from this pasture. By September the volunteer hairy indigo shown covered 96 percent of the surface.

Herbicidal residues injurious to young citrus trees may be expected to disappear within two months after the last application, provided the materials are used at the rates mentioned and rainfall is reasonably normal. The appearance of annual broadleaf weeds and grasses indicates a safe preplanting interval.

None of the herbicides discussed are presently approved by Federal regulatory agencies for use within citrus groves. Spray drift that contacts the tree or contaminates the root zone may result in tree injury.

The two large-scale field trials described, demonstrate the successful and economical elimination of pasture grasses from planting sites in the ridge areas of Central Florida. Plot trials in the coastal areas have indicated that paragrass and guineagrass also can be controlled by similar methods.

On new citrus planting sites, especially pastures, such grasses as pangola, torpedo, bermuda, bahia, para, guinea and maidencane are often a problem after trees are planted.

Weed pests, with the exception of torpedograss which has persistant rhizomes, can be controlled prior to setting trees by a combination of herbicides and tillage. At one site, plowing during a dry winter destroys 95 percent of pangola and spot spraying with dalapon eliminated the remaining grass. At another site, fall plowing destroyed 70 percent of grasses including bahia, pangola, bermuda and maidencane. The following spring, two sprays 10 days apart and totaling 15 pounds of commercial (74 percent) dalapon eliminated all grass. Dalapon, sodium TCA, diuron, and 2,4,5-T are useful planting site herbicides under suitable conditions.

LITERATURE CITED

1. Simanton, W. A. and J. R. King. Weed control problems in Florida citrus groves. Proc. Soil and Crop Sci. Soc. of Florida 16: 297-304. 1956.

2. Seale, C. C., J. W. Randolph and V. L. Guzman. 2,4-D for post emergence weed control in the Everglades. Florida Agr. Exp. Sta. Bul. 532. 36 pp. 1953.

POTASH RELATIONSHIPS IN COMMERCIAL GROVES

(Continued from page 16)

random samples of spring flush leaves from non-fruiting twigs were collected in August 1957. It will be noted that a wide range of leaf potash levels were obtained for both the Pineapples and the Valencias.

Some plots which received no potash for three years were found to have about the same level of leaf potassium as plots in other areas which had received potassium regularly.

Analysis of the data showed significantly more drops and split fruit in the zero potash plots. The correlation between leaf analysis and fruit drop scores was highly significant. Pineapple drops seemed to be more consistent in their relationship to leaf potash than Valencias and data from these plots have been plotted in Figure III.

Points representing the zero potash plots have been joined by a dotted line to show the linear relationship between leaf potash and fruit drop. Above 1.0% the data show no relationship. Trees with leaf potassium levels of 1.36% had almost as many drops as trees having 0.96% potassium in the leaves.

Discussion

Surveys of citrus groves have again demonstrated the value of having low leaf potassium levels for increased solids in oranges. Experience with the leaf sampling procedure has shown that leaf potassium-fruit quality relationships are not consistent. There are many factors which can influence fruit quality and it should not be surprising that in some years the effects of potash are not apparent in simple correlation studies.

Koo (3) has found that fruit sizes increased with increased potash and decreased with increased nitrogen. When the effects of nitrogen were eliminated by a multiple correlation analysis, he was able to show the significant relation between fruit size and leaf potassium. It is probable that the leaf potassium-fruit quality relationships are valid even in years when they cannot be readily demonstrated.

Thus the leaf sampling procedure provides a good index to the potassium nutritional statue of groves for fruit quality purposes. If leaf potassium values are high, we can expect to produce more fruit solids by adjusting the fertilizer program until the leaf values drop.

Leaf potassium was found to vary in an unpredictable manner from one year to the next and from one grove to another. In the extreme case where potash was left out of the program for three years there were plots having the same level of leaf potassium as plots in other areas where potash was used regularly.

It is not possible to control or even estimate the effects of the many factors associated with potash utilization by citrus trees. This is particularly true where the trees are under no stress for potassium. Leaf potassium values ranging from one to two percent in our surveys could not be used for fine adjustments in the fertilizer program. A reduction in potash fertilizer was continued for two more years before consistent reductions were obtained in leaf potassium.

Groves responded differently to reduced potash fertilizer as illustrated by the experimental plots. A lower limit for leaf potassium to guard against possible losses in yield

is the most practical control which can be suggested at this stage of our experience.

There is some doubt as to what may be a safe lower limit to put on leaf potassium for control purposes. Average values for California and Texas were 0.71 and 0.73% in a 1952 survey (5). Healthy high yielding groves in California are reported to have values ranging from 0.40 to 1.00% (1). Reitz (4) has reported an average of 1.15% for the Indian River and Koo's 1955 survey of Valencia groves in Central Florida (3) showed a range of 1.04 or 2.77%, with an average of 1.84%.

It is possible that the potash requirements in different citrus growing areas may be different. Our work with groves in Central Florida has indicated that leaf potassium levels of around 0.8% and lower can be associated with an increased fruit drop and a probable decrease in yields in some years. Considering the precision of the samples and the year to year variability, leaf potassium values should not be permitted to drop below 1.0% in five to seven month old leaves.

Table 4
Average Scores for Fruit Drops and Splits in Minute Maid Potash Experiments.

	Plots Receiving No Potash			Plots Receiving Potash		
Variety	% Potassium in Leaves	Fruit Drop Scores (1)	Fruit Split Scores (2)	% Potassium in Leaves	Fruit Drop Scores (1)	Fruit Split Scores (2)
Pineapple						
17 NW20	.62	2.50	1.25	1.15	1.41	1.21
17 SW20	.96	2.03	1.78	1.17	1.85	1.10
17 NW29	.81	2.27	1.30	1.36	1.94	1.24
17 SW29	.72	2.31	1.44	1.22	1.74	1.18
Luc. 165	1.15	1.51	1.56	1.32	1.54	1.51
Average	.85	2.12	1.47	1.24	1.70	1.25
Valencia						
17 NW20	.64	2.33	2.92	1.10	1.62	2.36
17 SW20	.76	2.40	2.93	1.20	1.80	2.38
17 NW29	.88	2.18	2.66	1.27	2.06	2.49
17 SW29	.72	2.03	2.83	1.27	2.03	2.69
Luc. 164	1.00	2.50	2.79	1.42	2.25	2.88
Lynch .12	1.05	2.00	2.88	1.44	1.49	2.10
Average	.84	2.24	2.84	1.29	1.88	2.59

(1) Fruit Drop Scores 1. Less than 6 fruit on the ground.
2. Could count up to about 20 fruit on ground.
3. More than 20 fruit on the ground.
(2) Fruit Split Scores 1. No split fruit on the ground.
2. Less than 6 split fruit on ground.
3. More than 6 split fruit on ground.
Individual trees were scored. Each figure for drops and split fruit is an average value for 40 trees.

Summary & Conclusions

Surveys have shown that high solids in Pineapple and Valencia orange groves are associated with low leaf potassium. These findings agree with previously published results of fertilizer experiments and help to demonstrate the value of the leaf sampling procedure in citrus groves.

The leaf potassium-fruit quality relationships were not consistent over a seven year period. It was recognized that many factors influence fruit quality but the effects of potash were still valid, even in years when they could not be demonstrated in simple correlation studies. Thus the sampling procedure is a good index to the potassium nutritional status of orange groves.

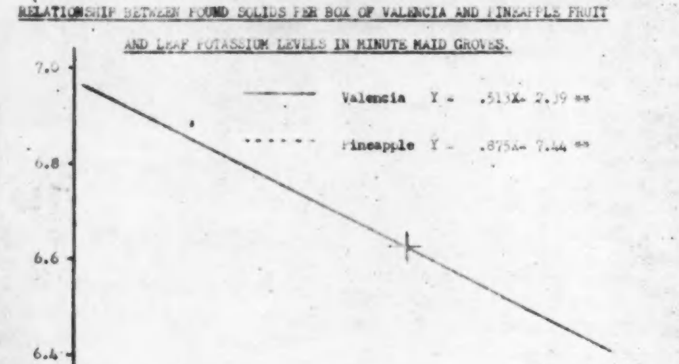
The potential increase in fruit solids production with decreased potassium is an incentive for developing control methods for fertilizer programs based on leaf analysis. Experience has shown that leaf potassium varies considerably from year to year with little or no relationship to the potash fertilizer program.

The groves were under no nutritional stress for potash and, in the ranges encountered, leaf analysis was of no value for making small changes in the potash applied with predictable results in the following year. The leaf sampling procedure can detect deficient and excessive levels of potassium and with a lower limit established as a guide it can assist in developing fertilizer programs in groves having different potash requirements.

Potassium levels of 0.8% and less were found associated with fruit

FIGURE II

RELATIONSHIP BETWEEN POUND SOLIDS PER BOX OF VALENCIA AND PINEAPPLE FRUIT AND LEAF POTASSIUM LEVELS IN MINUTE MAID GROVES.



** Correlation coefficients significant at the 1.0% level.

drop and probably losses in yields. There is evidence that levels of 0.8% leaf potassium are not always associated with reduced yields. However, considering the precision of the sampling procedure and the year to year variability in potash utilization, it is recommended that the potassium level of five to seven month old spring flush leaves should not be permitted to drop below 1.0% for fertilizer control purposes.

References

(1) Chapman, H. D. & Brown, S. M. Analysis of Orange Leaves for Diagnosing Nutrient Status With Reference to Potassium. Hilgardia 19: 501-539. 1950.

(2) Harding, P. L. & Lewis, W. E. The Relation of Size of Fruit to Solids, Acid and Volume of Juice in the Principle Varieties of Florida Oranges, Proc. Florida State Hort. Soc. 54: 52-56. 1941.

(3) Koo, R. C. J., Reitz, H. J. & Sites, J. W. A Survey of the Mineral Nutrition Status of Valencia Oranges in Florida. University of Florida Agricultural Experiment Station Bulletin (in press). 1958.

(4) Reitz, H. J. & Long, W. T. Mineral Composition of Citrus Leaves from the Indian River Area of Florida, Proc. Florida State Hort. Soc. 65: 32-38. 1952.

(5) Reuther, W., Smith, Paul F. & Specht, A. W. A Comparison of the Mineral Composition of Valencia Orange Leaves from the Major Producing Areas of the United States, Proc. Florida State Hort. Soc. 62: 38-45. 1949.

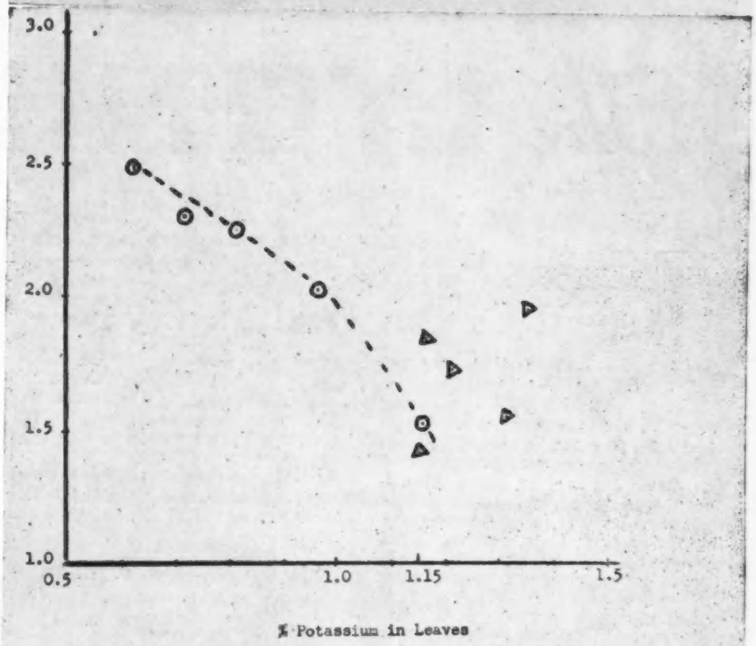
(6) Reuther, W. & Smith, P. F. Relation of Fertilizer Treatment to Fruit Quality of Valencia Oranges, Proc. Florida State Hort. Soc. 64: 29-34. 1951.

(7) Sites, J. W. & Deszyck, E. J. Effect of Varying Amounts of Potash on Yield and Quality of Valencia and Hamlin Oranges, Proc. Florida State Hort. Soc. 65: 92-98. 1952.

(8) Willson, A. E., Arey, W. J. & Bistline, F. W. Errors in Citrus Soil and Leaf Sampling Procedures, Proc. Florida State Hort. Soc. 68: 107-112. 1955.

FIGURE III

PINEAPPLE FRUIT DROP SCORES RELATED TO LEAF POTASSIUM



Note 1. Points marked ⊙ represent data from zero potash plots.
Points marked ▲ represent data from plots where potash was applied.

2. Each point represents the average score for 40 trees.

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The 1959 Better Fruit Program Spray and Dust Schedule published annually by the Florida Citrus Commission is now being distributed throughout the State.

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Reports Of Our Field Men . . .

SOUTH HILLSBOROUGH, MANATEE AND SARASOTA COUNTIES

Eaves Allison
P. O. Box 365, Sarasota, Fla.
Phone Fulton 8-2611

Citrus damage, in spots, is evident throughout this area on new growth only. Both on young trees and nursery stock and on some older trees in the tops and on exposed sides. No evidences of any heavy damage anywhere. This from the early January cold snap, of course. At this writing it is cold again, Jan. 17th. but as this goes to the post office there is no certainity of how low the temperature will really go. Not too bad is the production.

The early January cold got all the old tomatoes, but as they were about through picking anyway the loss was small. The new crop was just coming up in the field and in practically all cases escaped damage in the Palmetto-Ruskin area. Watermelons, squash and other tender stuff was mostly lost or badly damaged. Some large fields set to tomato plantings were also lost.

Citrus prices are firmly high and no complaints on that score. Florida red scale is still hanging on, though of course pretty dormant in this weather. However, control measures haven't been too effective this past season. Rains have been ample, in fact too ample. All we need at this time is some good old Florida sunshine and plenty of that good old Lyons Fertilizer!

SOUTH POLK, HIGHLANDS, HARDEE AND DeSOTO COUNTIES

C. R. Wingfield
Phone: Glandale 2-8181
Avon Park, Fla.

The second and third week-ends of January brought back to mind the same period of last year. The temperatures became rather low and there was a lot of damage to young trees and any new growth on older trees. At the time of this writing it is not possible to estimate the extent of damage to the fruit. I believe there was some ice in the fruit in some locations. Readings through this section ranged from 24 to 32 degrees depending on locations. Where readings of 28 degrees lasted for 3 to 4 hours it would be reasonable to think there was ice. There were two heavy frosts that added to the damage from cold winds.

In this section there were very little vegetable crops planted with the exception of watermelons.

NORTH CENTRAL FLORIDA

V. E. Bourland
Winter Garden, Fla.
Phone 107

We have had some winter weather since my last report, one of the biggest frosts that I have seen in a long time, which got lots of young tender growth on trees, I don't think any old wood was hurt to speak of. There wasn't too much damage to fruit.

Fruit is still moving steadily. lots of tangerines still on trees, and I think grapefruit in this section is being moved a little slower than usual. The cold hurt the truck farmers considerably, and pastures are all brown from frost, and cattlemen are having to feed their cattle.

WEST HILLSBOROUGH AND WEST PASCO COUNTIES

J. A. Hoffman, Lutz, Fla.
Phone WE 9-2069

The recent cold spell doesn't appear at this time to have done much damage to citrus in this area. Some young trees with tender growth were nipped, but not to the extent that it would cause severe damage to the trees. The damage might have been more severe, but most trees froze last year in the cold pockets that occurred this year.

Moisture conditions are very good and many growers are starting to apply their Spring top dresser at this time.

Red spiders are quite active at this time, but so far leaf drop has been light. A control measure should be used as soon as possible where mite infestation is heavy.

Most all early and mid-season fruit has been picked. Valencia oranges appear to be a little small and the crop lighter than usual.

HIGHLANDS AND POLK COUNTIES

R. E. Lassiter, Jr.,
P. O. Box 1304
Winter Haven, Fla.

At the time of this writing we are approximately one week away from our last cold wave. We received at that time quite a lot of damage to the younger and more tender foliage which was present. There was also some splitting of the wood on this young growth. The weatherman is telling us at this time that more cold weather is on its way, and growers are readying themselves to do some firing. As of yet we have noticed very little fruit damage from this cold, but chances are that there is more fruit damaged than we have yet realized.

We should still be on the lookout for insects such as the rust mite, purple and Texas mite, and scale. Additional foliage damage following the loss of foliage from cold would be most undesirable. Groves which have received heavy defoliation should receive complete nutritional spray at post bloom time as deficiency symptoms usually appear following severe defoliation.

Growers are beginning to concern themselves with their Spring fertilizer application. By the first of February this application should be well on its way. Growth following damage from cold, especially in cases of severe damage, will probably be weak and should have an application of fertilizer in order to help make this growth as strong as possible.

NORTH CENTRAL FLORIDA

L. D. Geiger, Jr.,
Phone STATE 7-3952
Leesburg, Fla.

In north-central Florida the weather has been rather chilly the last couple of weeks. There was quite a bit of damage to young trees and cut-back trees. In some places the bark on young trees was split.

Most melon growers have completed their fertilizing and some have already planted.

The vegetable growers in the Sanford area are still very busy with cabbage being a large crop for some growers. Lettuce is also still in good shape with little apparent damage due to the cold.

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